1,172,608

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in screw-threaded bottle closures.

We, TREVOR GWILYM EVANS, MICHAEL JAMES and GEOFFREY ALAN RYDER, all British subjects, trading as the firm DESIGN LINK, of Fretherne Chambers, Fretherne Road, Welwyn Garden City, Hertfordshire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to screw-threads which have a self-locking characteristic for making screw-threaded container closures self-locking in such a way that so great a torque is necessary to unscrew the closure that a child would find it more difficult to open than an ordinary screw cap. The invention is therefore particularly useful in connection with containers for pharmaceutical or other dangerous substances which are commonly found in the home but which must be kept away from children.

The aim of the present invention is to provide a self-locking screw-thread which can be constructed in such a way that the torque which resists unscrewing persists even after the thread has been unscrewed to a small extent. Further, the thread can be manufactured by a moulding technique without very close tolerances being required and it can be applied to moulded parts of small wall thickness which can be cheaply manufactured.

According to this invention, a container or closure therefor includes a screw-threaded part having a thread profile with a step in that flank of the thread which trails as the thread is screwed up, the thread profile being such that when the part is screwed tightly onto a cooperating thread, the crest of the cooperating thread is forced onto the step and the two threads are frictionally held tightly against release.

In the particular case of a bottle with an externally screw-threaded neck and a cap with an internally threaded skirt, the thread having a profile with a step in its flank is preferably provided on the cap, which may be moulded out of flexible plastics material and the thread on the neck of the bottle is then of conventional design. Thus in this case, the cap has an internally screw-threaded skirt which forms the screw-threaded part, the step being formed in the flank of the thread which is directed away from the open end of the skirt.

Where, as an alternative, however, the cap is provided with a conventional thread, the thread on the bottle neck has a thread profile with a step in the flank which is directed away from the open end of the neck.

In either case, to enable the crest of the cooperating thread to ride onto the step, some degree of resilience is necessary in the bottle or the cap and the amount of interference provided between the crest of the cooperating thread and the step is dependent upon the degree of resilience. When the crest of the cooperating thread is on the step, a radial thrust is exerted between the two and therefore the frictional resistance encountered when the cap is to be unscrewed is greater than that encountered with a normal screw cap. To remove the cap from the bottle, the cap must be unscrewed to such an extent that there is sufficient axial play between the cap and the bottle to allow the cap to be moved on the bottle to force to crest of the cooperating thread off the step back towards the root of the stepped thread where there is a clearance. After this has been done, the cap can easily be unscrewed in the same way as a normal cap provided with a clearance over the whole of its thread profile, but until the crest of the cooperating thread can be forced from the step the frictional resistance which opposes the unscrewing of the cap continues while the cap is unscrewed whereas with a conventional screw cap, once the initial re-

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sistance is overcome the cap is at once loose.

With a container or cap having a thread in accordance with the invention, a child will not only find the cap hard to turn from its fully screwed up position, but the child must continue to turn the cap for some distance against the frictional resisting torque before the cap can be loosened and removed. Therefore even though a child may be able to produce instantaneously the necessary torque to move the cap, it is unlikely that the child would be able to produce this torque for sufficient time to loosen the cap completely.

Apart from this resistance to unscrewing which provides a child safety characteristic, however, a part, and in particular a bottle or cap, provided with a thread in accordance with the present invention has an advantage which is capable of even more widespread use than applications where a degree of resistance to opening by children is necessary. Thus, owing to the inaccuracies which necessarily occur in the production of screw-threads on bottles or moulded caps, it is necessary with conventional threads to provide a tolerance which gives rise to a substantial clearance between the thread on the bottle and thread on the cap. As the conventional threads are screwed up or unscrewed, the cap may be displaced radially on the bottle neck in such a way that there is no clearance between the cap and bottle threads at one side of the bottle but a substantial clearance at the other side. If there is any resilience, as is usually the case with caps moulded out of plastics material, especially thermoplastics material, there is a tendency for the thread to deflect locally at the point of maximum clearance as the cap is screwed upon the bottle and what is known as "peeling of the thread" may then take place. This means that the thread on the bottle and thread on the cap ride over each other at the point of deflection of the cap thread so that the thread is no longer effective in anchoring the cap in position on the bottle.

In order to prevent this happening, it is necessary to make the skirt of the cap of sufficient rigidity to prevent the local deflection of the thread, which gives rise to thread peeling, from taking place. This makes it necessary to make the skirt of the cap thicker than is necessary from other considerations of the strength of the cap.

When either the cap or the bottle is provided with a stepped thread in accordance with the present invention, however, although there may be a substantial clearance between the crest of the cooperating thread and the root of the stepped thread to allow for normal manufacturing tolerances, it is possible for there to be a substantial interference between the step and the crest of the cooperating thread so that even allowing for tolerances there is still some interference. Thus as the crest of the cooperating thread starts to ride onto the shoulder, there is no clearance at all at any point around the cap and the neck of the bottle. There is thus continuous line contact between the two threads and owing to this lack of clearance the cap is automatically centred on the bottle neck. Because there is no excessive clearance at any point, so that the thread on the skirt of the bottle cap is supported all the way round, there is no possibility of any local deformation of this thread taking place. Thread peeling cannot therefore occur and it is possible to make the skirt of the bottle cap of very much thinner material than would otherwise be possible whilst still ensuring that the thread securely anchors the cap in position on the bottle.

This feature is of particular importance with bottle caps made of polypropylene and other quite flexible thermoplastics materials and it enables caps to be made of these materials with very much thinner sections than would otherwise be possible. Since a considerable proportion of the total cost of a cap lies in the cost of the material from which it is made, there is an extremely worthwhile overall reduction in the cost of the cap.

A still further advantage of the self-locking thread is that it greatly assists in resisting "backing off" which is an inherent tendency existing with all screw-threaded closures to come loose with vibration. The tendency is a result of the axial locking force which exists between the two threads and the helix angle of the threads which together tend to unscrew the closure. Backing off may occur which the compression of parts of a closure or of a wad within the closure relaxes or the container and its closure is subjected to vibration such as is experienced in transit.

The face of the step onto which the crest of the cooperating thread is forced when the two threads are fully tightened together may be concave so that the crest of the cooperating thread fits into the step to some extent. That is to say in the locked position, the step engages over and around the crest of the cooperating thread. In this case, as the two threads are unscrewed, the crest of the cooperating thread will remain on the step and to release it, not only must the two threads be unscrewed from each other sufficiently, but the two threads must be pressed axially to force the crest of the cooperating thread off the step. In the case of a bottle and cap, the cap must be unscrewed and then pressed downwards onto the bottle until the cooperating thread snaps free into the clearance around the root of the stepped thread. In the case of bottles for pharmaceutical products and other materials which must be kept out of the reach of children,

the shaping of the step in this way provides added safety since most children would not follow the sequence of actions consisting of unscrewing the cap and then pressing it downwards, their natural tendency being to pull the cap off rather than to push it down as they unscrew it.

If on the other hand the step is flat in an axial direction so that it does not extend in engagement with the cooperating thread over and around the crest of the cooperating thread, the cooperating thread will tend to jump off the step as soon as the two threads have been unscrewed sufficiently.

An example of a screw-threaded cap and of a container constructed in accordance with the invention are illustrated in the accompanying drawings in which:—

Figure 1 is a diametric section through a bottle cap in accordance with the invention shown in the course of being screwed onto a bottle neck provided with a conventional thread;

Figure 2 is a diametric section similar to Figure 1, but showing the cap at a later stage of its being screwed onto the neck;

Figure 3 is a section similar to Figures 1 and 2, but showing the cap screwed fully onto the neck of the bottle;

Figure 4 is a perspective view to a smaller scale of the cap shown in Figures 1 to 3;

Figure 5 is a side elevation of the neck of a bottle in accordance with the invention with a cap, shown in diametric section, in the course of being screwed onto the bottle neck; and,

Figure 6 is a view similar to Figure 5, but showing the cap screwed fully onto the bottle neck.

In the example illustrated in Figures 1 to 4 of the drawings, a glass bottle 1 has a neck 2 provided with a thread 3 of a conventional rounded profile.

A closure cap 4, which in this example, is made of polypropylene by injection moulding, but may be made by compression moulding, has a top wall 5 and a skirt 6. Inside the inner end of the skirt 6 is a resilient sealing wad 7 and the outside peripheral surface 8 of the skirt 6 is provided with a series of axially extending ribs to enable it to be firmly gripped.

The skirt 6 is provided with an internal screw-thread 9, the profile of which has a straight root section 10 and also a straight leading flank 11 which is the flank which is on the side of the thread adjacent the open end of the skirt 6.

The other flank of the thread 9, that is the flank directed towards the top wall 5 and away from the open end of the skirt of the cap, has a straight portion 12 and a step 13. The step 13 is concave as seen in radial section in Figures 1 to 3 of the drawings and extends from the edge of the straight portion 12 up to a crest 14.

The diameter of the root 10 is such that it has a substantial clearance around the crest of the thread 3, but the diameter of the radially outermost part of the step 13 is such that even allowing for manufacturing tolerances, it has an interference fit with the crest of the thread 3. Thus, as the cap 4 is initially screwed onto the neck 2, the crest 14 rides on the uppermost flank of the thread 3 and there is a clearance between the crest of the thread 3 and the root 10 and also between the crest 14 and the root of the thread 3.

As screwing on of the cap 4 continues, an end face 15 of the neck 2 comes into contact with the underside of the wad 7 so that there is an upward axial thrust applied to the cap 4 by the neck 2. This causes the thread 9 to ride up towards the thread 3 until the position shown in Figure 2 of the drawings is reached. Here, a corner 16 of the step 13 has come into contact with the thread 3 just below its crest.

As screwing on of the cap 4 continues, the wad 7 is further compressed and the axial force between the neck 2 and the cap 4 increases until the crest of the thread 3 is forced onto the step 13 around the whole extent of the two threads as is shown in Figure 3 of the drawings.

When this stage is reached, the cap 4 is held screwed onto the neck 2 not only by the frictional force generated by the axial thrust between the threads 3 and 9, which is dependent upon the screwing-on torque applied to the cap 4, but also by the frictional force generated by a radial thrust between the step 13 and the crest of the thread 3. This radial thrust is determined by the amount of interference between the step 13 and the crest of the thread 3 and is independent of the torque applied to the cap 4 to screw it on, provided that this is sufficient to force the crest of the thread 3 up onto the step 13.

As the cap 4 is unscrewed again, the frictional torque resisting unscrewing provided by the axial thrust between the neck 2 and the cap 4 immediately decreases and falls to zero as soon as the wad 7 is no longer compressed. However, the crest of the thread 3 remains on the step 13 so that the friction brought about by the radial force between the threads persists and this continues until the cap 4 has been unscrewed sufficiently far to enable the cap 4 to be pressed downwards and cause the crest of the thread 3 to be moved off the step 13.

To assist in tightening and unscrewing the cap 4, this is provided with a pair of parallel ribs 17 projecting upwards from its top wall 5 to enable a coin shown in chain-dotted lines at 18 in Figure 4 to be inserted between the ribs and act like a screw driver.

In the example shown in Figure 5 and 6

of the drawings, a bottle 21 has a neck 22 provided with a screwthread 23. A cap 24 has a top wall 25 with a skirt 26 and an internal wad 27. The bottle including the thread on the neck is made by a conventional technique, for example extrusion/blow-moulding or injection/blow-moulding when made of thermoplastics material or parison blow-moulding when made of glass.

In this example, the skirt 26 has an internal thread 29 of conventional profile with straight flanks 30 and a straight crest 31. The thread 23 has a straight flank 32 on the side of the thread adjacent the open end of the neck 22 and a flank on its side directed away from the open end of the neck which has a straight portion 33 adjacent its crest 34 and a step 35 leading to a straight portion 36 adjacent its root 37.

The crest of the thread 29 has a clearance around the root 37, but is an interference fit with the step 35.

As the cap 24 is first screwed on, the threads adopt the positions shown in Figure 5 of the drawings in which the crest 34 rides on the lowermost flank 30 of the thread 29.

As the cap 24 is tightened, however, and there is an axial thrust between the wad 27 and an end surface 38 on the neck 22, the thread 29 is forced to ride up on to the thread 23 through a position corresponding to the position shown in Figure 2 of the drawing into a fully locked position shown in Figure 6 of the drawings in which the crest 31 is forced onto the step 35.

Under these conditions, there is a radial thrust between the threads 23 and 29 which produces a locking torque in exactly the same way as in the example illustrated in Figures 1 to 4. This locking torque persists on unscrewing the cap 24 until it is possible to push the cap downwards relatively to the neck 22 so that the crest 31 is pushed off the step 35.

In the example shown in Figures 5 and 6 the cap 24 may, of course, if desired be provided with ribs similar to the ribs 17 in the example illustrated in Figures 1 to 4 or with other means for facilitating screwing up and unscrewing the cap.

WHAT WE CLAIM IS:—

1. A container or closure therefor including a screwthreaded part having a thread profile with a step in that flank of the thread which trails as the thread is screwed up, the thread profile being such that when the part is screwed tightly onto a cooperating thread, the crest of the cooperating thread is forced onto the step and the two threads are frictionally held tightly against release.

2. A closure according to Claim 1, in the form of a bottle cap with an internally screw-threaded skirt which forms the screw-threaded part, the step being in the flank of the thread which is directed away from the open end of the skirt.

3. A container or closure according to Claim 1, or a closure according to Claim 2, in which the profile of the step is concave so that, in use, the crest of the cooperating thread fits into the step and the step engages over and around the cooperating thread.

4. A closure according to Claim 2, or Claim 3 when dependent on Claim 2, which is provided on its top wall with a keying device for engagement of an implement to facilitate turning the closure.

5. A closure according to any one of the preceding claims, which is injection moulded out of polypropylene.

6. A closure according to Claim 1, constructed substantially as described with reference to Figures 1 to 3 of the accompanying drawings.

7. A container according to Claim 1, constructed substantially as described with reference to Figures 5 and 6 of the accompanying drawings.

8. A container according to any one of Claims 1, 3 and 7, in combination with a screw-threaded closure, the closure being screwed tightly onto the container with the crest of the thread of the closure in engagement with the step of the thread on the container so that the closure is frictionally held tightly against release.

9. A closure according to any one of Claims 1 to 6, in combination with a screw-threaded container, the closure being screwed tightly onto the container with the crest of the thread of the container in engagement with the step of the thread on the closure so that the closure is frictionally held tightly against release.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 1.

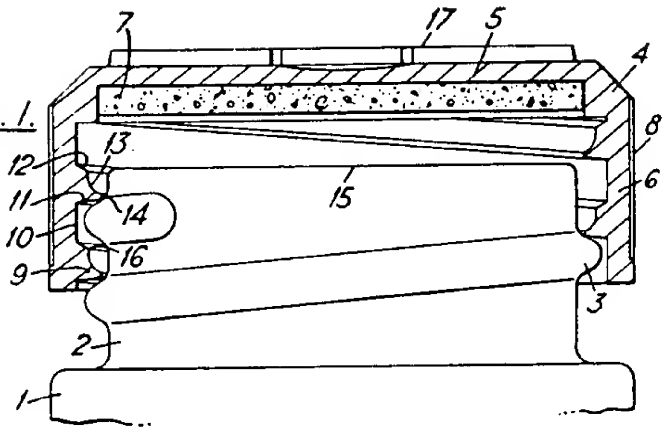


Fig. 2.

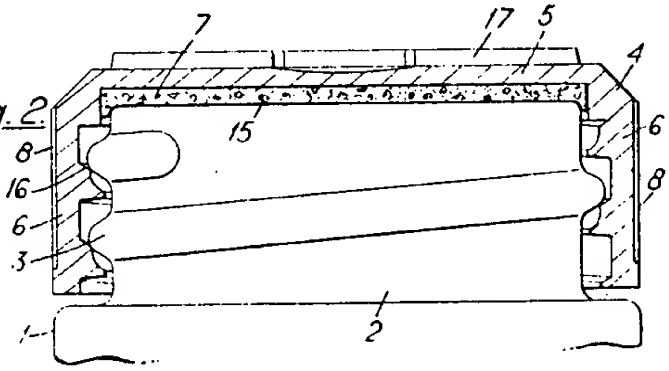
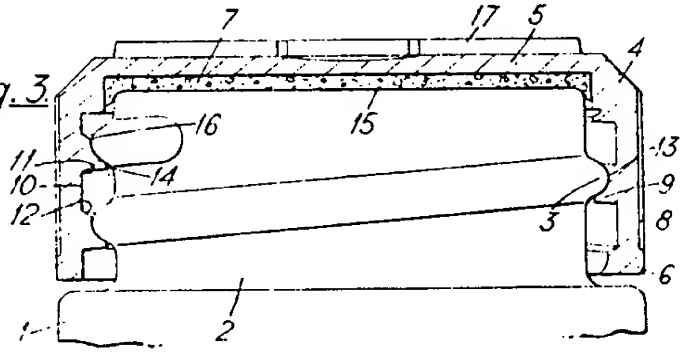


Fig. 3.



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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

Fig. 4.

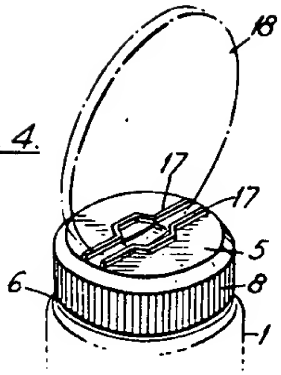

Fig. 5.

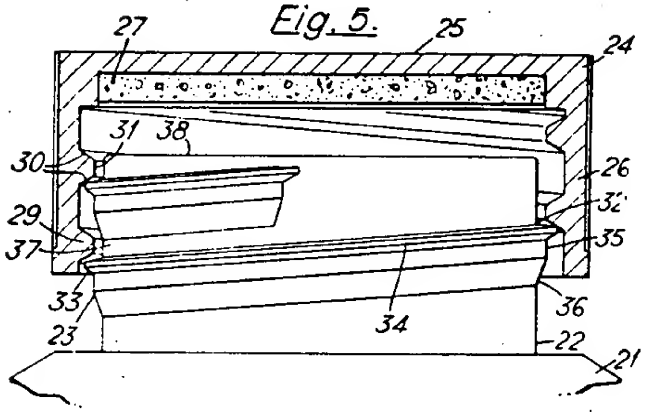

Fig. 6.